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TITLE: METHOD AND SYSTEM FOR VEHICLE SOFTWARE CONFIGURATION MANAGEMENT

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METHOD AND SYSTEM FOR VEHICLE SOFTWARE CONFIGURATION MANAGEMENT

FIELD OF THE INVENTION

In general, the invention relates to software configuration management. More specifically, the invention relates to a method and system for vehicle software configuration management.

BACKGROUND OF THE INVENTION

One of the fastest growing areas of communications technology is related to automobile network solutions. The demand and potential for wireless vehicle communication, networking and diagnostics services have recently increased. Although many vehicles on the road today have limited wireless communication functions, such as unlocking a door and setting or disabling a car alarm, new vehicles offer additional wireless communication systems that help personalize comfort settings, run maintenance and diagnostic functions, place telephone calls, access call center information, update controller systems, determine vehicle location, assist in tracking vehicle after a theft of the vehicle and provide other vehicle related services. Drivers can call telematic call centers and receive navigational, concierge, emergency, and location services, as well as other specialized help as locating the geographical location of a stolen vehicle and honking the horn of a vehicle when the owner cannot locate it in a large parking garage.

Controllers and software play a large role in the automation of an increasing number of vehicle functions. With the constant evolution of technologies, upgrades are frequently made to vehicle software modules to provide additional vehicle features or improve the performance of existing vehicle functions. The installation of upgraded software modules are currently handled manually by vehicle technicians at a vehicle dealership. Often times, there are long time gaps between visits to a vehicle dealership. As a result, the vehicle may not be available for a vehicle technician to manually upgrade the vehicle software modules to newer versions of vehicle software modules thereby depriving the vehicle owner of software upgrades and improved functionality of the vehicle.

Also malfunctioning telematics units are replaced in vehicles with new telematics units or telematics units taken from other vehicles. Newly installed telematics unit require the installation of software module specific to the vehicle. In many cases, controller operated vehicle devices require replacement. The replacement of such vehicle devices often require the reinstallation of software modules necessary for the operation of the vehicle devices. The manual installation of vehicle specific software can require costly vehicle technician time and may be time consuming.

It is desirable therefore, to provide a method and system for vehicle software configuration management, that overcomes the challenges and obstacles described above.

SUMMARY OF THE INVENTION

One aspect of the invention presents a method for managing a software configuration of a vehicle. The method comprises requesting a software configuration update data for a vehicle from a central database from one of a call center or a telematics unit and retrieving a vehicle software configuration data representative of a vehicle software configuration. It is determined whether the software configuration update data corresponds with the vehicle software configuration data. A software module is sent from the call center to the telematics unit via a wireless network based on the determination.

Another aspect of the invention presents a computer readable medium storing a computer program for managing a software configuration of a vehicle. The computer readable medium comprises computer readable code for requesting a software configuration update data for a vehicle from a central database from one of a call center or a telematics unit and computer readable code for retrieving a vehicle software configuration data representative of a vehicle software configuration. The computer readable medium further comprises computer readable code for determining whether the software configuration update data corresponds with the vehicle software configuration data and computer readable code for sending a software module from the call center to the telematics unit via a wireless network based on the determination.

Another aspect of the invention provides a system for managing a software configuration of a vehicle. The system comprises means for requesting a software configuration update data for a vehicle from a central database from one of a call center or a telematics unit and means for retrieving a vehicle software configuration data representative of a vehicle software configuration. The system further comprises means for determining whether the software configuration update data corresponds with the vehicle software configuration data and means for sending a software module from the call center to the telematics unit via a wireless network based on the determination.

The foregoing and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiment, read in conjunction with the accompanying drawings. The detailed description and drawings are merely illustrative of the invention rather than limiting the scope of the invention being defined by the appended claims and equivalents thereof.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a schematic diagram of a system for managing software configuration of a vehicle in accordance with one embodiment of the present invention;

FIG. 2 is a schematic diagram of the telematic call center and a vehicle in accordance with one embodiment of the present invention;

FIG. 3 is a flowchart for managing software configuration of a vehicle in accordance with one embodiment of the present invention;

FIG. 4 is a flowchart for updating the software configuration data in a telematics unit in accordance with one embodiment of the present invention; and

FIG. 5 is a flowchart for upgrading the software modules in a vehicle in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE
PRESENTLY PREFERRED EMBODIMENTS

FIG. 1 is a schematic diagram of a system for vehicle software configuration management using a wireless communication system in accordance with one embodiment of the present invention at **100**. The vehicle software configuration management system **100** includes one or more vehicles **110**, a telematics unit **120**, one or more wireless carrier systems **140** or satellite carrier systems **141**, one or more communication networks **142**, and one or more call centers **180**. The vehicle **110** is a vehicle such as a car or truck equipped with suitable hardware and software for transmitting and receiving voice and data communications.

The vehicle **110** via the telematics unit **120** transmits and receives radio transmissions from the wireless carrier system **140**, or the satellite carrier system **141**. The wireless carrier system **140**, the satellite carrier system **141** or any other suitable communication system communicatively couples the vehicle **110** to the communication network **142**.

The communication network **142** includes services from mobile telephone switching offices, wireless networks, public-switched telephone networks, and Internet protocol (IP) networks. The communication network **142** comprises a wired network, an optical network, a fiber network, another wireless network, or any combination thereof. The communication network **142** is communicatively coupled to the vehicle **110** via the wireless carrier system **140**, or via the satellite carrier system **141**. The communication network **142** communicatively couples the wireless carrier system **140** or the satellite carrier system **141** to a user computer **150**, a wireless or wired phone **160**, a handheld device **170**, such as a personal digital assistant, and the call center **180**. The communication network **142** uses any appropriate wireless technology, including CDMA, TDMA, FDMA, and GSM or satellite carrier system.

The communication network **142** can transmit and receive short messages according to established protocols such as IS-637 standards for short message service (SMS), IS-136 air-interface standards for SMS, and GSM 03.40 and 09.02 standards.

The call center **180** is a location where many calls can be received and serviced at the same time, or where many calls can be sent at the same time. In one embodiment, the call center **180** is a voice call center, providing verbal communications between a communication services advisor **185** in the call center **180** and a subscriber. In another embodiment, the call center **180** contains any combination of hardware or software facilitating data transmissions between the call center **180** and the vehicle **110**. In one embodiment of the invention, the call center is a telematics call center, facilitating communications to and from the telematics unit **120** in the vehicle **110**. In a further embodiment, the call center **180** is any combination of the previously described functions.

The communication services advisor **185** is a real advisor or a virtual advisor. A real advisor is a human being in verbal communication with a user or subscriber. A virtual advisor is a synthesized voice interface responding to requests from user or subscriber. In one embodiment, virtual advisor includes one or more recorded messages. In another embodiment, virtual advisor generates voice messages using a text to speech synthesis engine (TTS). In another embodiment, the virtual advisor includes both recorded and TTS generated messages.

The call center **180** provides services to telematics unit **120.** The communication services advisor **185** provides one of a number of support services to a subscriber. The call center **180** can transmit data via data signal, such as a vehicle data upload (VDU), to the telematics unit **120** in vehicle **110** through wireless carrier system **140**, satellite carrier systems **141**, or communication network **142**.

In one embodiment of the invention, the user **172** has a local provisioning system such as a user computer **150** or a handheld device **170**. The local provisioning system has a wireless modem to send data through wireless carrier system **140**, or satellite carrier system **141,** which connects to communication network **142**. In another embodiment, local provisioning system has a wired modem, which connects to communications network **142**. The data is received at call center **180**. The call center **180** has any suitable hardware and software capable of providing web services to help transmit messages and data signals from local provisioning system, such as, a user computer **150** or a handheld device **170** to the telematics unit **120** in the vehicle **110**. In another embodiment, a user computer **150** or a handheld device **170** has suitable hardware and software to connect to the vehicle **110** using a direct link to a vehicle onboard data port.

In one embodiment of the invention, the telematics unit **120** includes a digital signal processor (DSP) **122** connected to a wireless modem **124**, a global positioning system (GPS) receiver or GPS unit **126**, and an in-vehicle memory **128**. The DSP **122** is also referred to as a microcontroller, ASIC, controller, host processor, or vehicle communications processor. The GPS unit **126** provides longitude and latitude coordinates of the vehicle **110**, as well as a time stamp and a date stamp. In one embodiment of the invention, DSP **122** is connected to at least one of a wireless microphone **130**, one or more speakers **132**, an embedded or in-vehicle phone **134** and an email access appliance **135**

The telematics unit **120** is communicatively coupled to various vehicle components via a vehicle communication bus **112.** Examples of vehicle components include vehicle control modules **114**, and vehicle sensors **116**. Many vehicle components **114, 116** require a dedicated software module to enable operation of the vehicle component **114, 116.** Examples of vehicle control modules **114** include, but are not limited to, the engine control module and the brake control module. In one embodiment, illustrated and explained in

greater detail below in **FIG. 2**, vehicle components **114, 116** that require a dedicated software module include a module processor **131** in communication with a module memory **132**. In another embodiment, vehicle components **114, 116** that require a dedicated software module include a module memory **132** in communication with vehicle communication bus **112**. In facilitating interactions among the various communication and electronic modules, vehicle communication bus **112** utilizes bus interfaces such as controller-area network (CAN), J1850, International Organization for Standardization (ISO) Standard 9141, ISO Standard 11898 for high-speed applications, and ISO Standard 11519 for lower speed applications. Module processor **131** and module memory **132** may be independent from vehicle components **114**, **116** (as illustrated in **FIG. 1**), or module processor **131** and module memory **132** be part of vehicle components **114**, **116** (as illustrated in **FIG. 2**)

FIG. 2 is a schematic diagram of a telematics call center **180** of **FIG. 1** and a vehicle **110** of **FIG. 1** in accordance with one embodiment of the present invention at **200**. Like numbers of **FIG. 2** describe like structures described in FIG. 1. The telematics call center **180** includes a server **181** and a central database **182**. The server **181** initiates requests to and responds to requests from the telematics unit **120** and facilitates the transfer of data between the central database **182** and the telematics unit **120**. The central database **182** maintains a record for every vehicle **110** in the software configuration management system **100** of **FIG. 1**. In one embodiment, a unique vehicle identification tag is assigned to every vehicle **110**. The vehicle specific records in the central database **182** are maintained according to the unique vehicle identification tag assigned to the vehicle **110**. In one embodiment, the unique vehicle identification tag is the vehicle identification number (VIN) for the vehicle **110**. Every vehicle **110** has its own record and every record includes vehicle specific software configuration data. The software configuration data for a vehicle **110** depends on vehicle specific factors including, but not limited to,

vehicle make, vehicle model, vehicle year, and customized vehicle features. Every vehicle **110** includes a predefined set of software modules to enable operation of many of the vehicle components **114, 116** of that vehicle **110**. Each vehicle component **114, 116** contains a module processor **131** in communication with module memory **132**. The software configuration data for a specific vehicle **110** includes a listing of the software identification tags for the most recent version of the predefined set of software modules. The software identification tag identifies the vehicle component **114, 116** that the software module is adapted to control and the software module version number.

The vehicle software configuration data is stored in the telematics unit **120**. The vehicle software configuration data includes a listing of the software identification tags for the software modules that the telematics unit **120** views as having been installed in the vehicle **110**. The software identification tags identify the vehicle component **114, 116** that the software module is adapted to control and the software module version number.

The actual software modules in the vehicle **110** reside in the vehicle component memory **132**. The vehicle component **114, 116** also stores the software identification tag for the actual software module in vehicle module memory **132**. For example, the engine controller software module resides in the engine controller module memory and the software identification tag associated with that software module in also stored in the engine controller module memory. The engine controller software identification tag identifies the software module as a engine controller software module and the version of the engine controller software module.

FIG. 3 is a flowchart for a method for managing the software configuration of vehicle **100** in accordance with one embodiment of the present invention at **300**. A predefined set of software modules are installed in new vehicles **110**. The method of managing the software configuration of the vehicle **110** enables the installation of the most recent versions of the software modules available at the central database **182** at the telematics call center **180**. In addition, vehicle software modules are periodically updated to provide additional vehicle features or improve performance of existing vehicle functions. The method of managing the software configuration of the vehicle **110** facilitates upgrading the vehicle software configuration in a vehicle **110** with the most recent versions of the software modules available at the telematics call center **180.** Also, controller operated vehicle components **114, 116** are often replaced during maintenance procedures and require the reinstallation of software modules for operation of the replaced vehicle components **114, 116**. The method of managing the software configuration of the vehicle **110** permits the installation of the more recent versions of the software modules available at the telematics call center **180** for operation of the replaced vehicle components **114, 116**. Furthermore, if a telematics unit **120** that was previously installed in a different vehicle **110**, is installed in another vehicle **110,** the method of managing the software configuration **300**, enables the reconfiguration of the telematics unit **120** and any necessary reconfiguration of the vehicle software. It should be noted that while a number of applications of the method of managing the software configuration of a vehicle **110** have been detailed, alternative applications and adaptations of the method and system for managing vehicle software configuration are considered to be within the scope of the invention.

The method for managing the software configuration of a vehicle **300** begins (**305**) with determining whether there is vehicle software configuration a trigger event (block **310**). A trigger event initiates the software configuration management of a vehicle **110.** In one embodiment, the telematics call center **180** issues an upgrade flag to the telematics unit **120** of a vehicle **110** when an upgraded version of a software module for the vehicle **110** becomes available thereby triggering the software configuration management of the vehicle **110.** In another embodiment, the telematics unit **120** of a vehicle **110** issues a status check flag to the telematics call center **180**. Receipt of the status check flag at the call center **180** triggers the software configuration management of the vehicle **110**. In another embodiment, the software configuration management of a vehicle **110** is triggered after a predefined period of time has elapsed following a previous vehicle software upgrade.

If no vehicle software configuration trigger event is detected, no further action is taken (block **315**). If a vehicle software configuration trigger event is detected, the telematics unit **120** requests software configuration data for the vehicle **110** from the telematics call center **180** (block **320**). The telematics unit **120** transmits a unique vehicle identification tag for the vehicle **110** to the server **181**. The server **181** uses the unique vehicle identification tag to search for the vehicle record in the central database **182**. The vehicle record includes the software configuration data for the vehicle **110**. The software configuration data includes the software identification tags for the most recent versions of the software modules available at the telematics call center **180** for the operation of the controller operated vehicle components **114, 116** in the vehicle **110**. The software configuration data is transmitted from the telematics call center **180** and received by the telematics unit **120** (block **325**). The telematics unit **120** retrieves the vehicle software configuration data (block **330**). The vehicle software configuration data is stored in the in-vehicle memory **128** and identifies

the software modules that have been installed in the vehicle **110**. The vehicle software configuration data includes a listing of the software identification tags for the software modules that have been installed in the vehicle **110**.

The telematics unit **120** compares the updated software configuration data received from the telematics call center **180** with the vehicle software configuration data (block **335**). If the list of software identification tags in the software configuration data matches the list of software identification tags in the vehicle software configuration data, the vehicle **110** has the most recent versions of the desired software modules and an update is unnecessary so the process ends (block **340**). If the list of software identification tags in the updated software configuration data does not match the list of software identification tags in the vehicle software configuration data, a request is made to the central database to update the software configuration data (block **345**). Upon receipt of the updated software configuration from the central database (block **350**), the vehicle software configuration data is updated in the in-vehicle memory **128** (block **355**).

If the list of software identification tags in the updated software configuration data does not match the list of software identification tags in the vehicle software configuration data, the vehicle software configuration data is updated with the updated software configuration data in the in-vehicle memory **128** (block **355**). Once the telematics unit **120** has the software configuration data identifying the specific software modules that should be installed in the motor vehicle **110** stored in the in-vehicle memory **128**, the telematics unit **120** initiates a process to update the vehicle software configuration. More specifically, the telematics unit **120** identifies and upgrades the actual software modules installed in the vehicle components **114, 116** if a more recent version of the software module is available (block **360**). In one embodiment, all communications and data transmissions between the telematics unit **120** and the telematics call center **180** are conducted via the wireless communication network.

FIG. 4 is a flowchart for updating the vehicle software configuration data in a telematics unit **120** to reflect the software identification tags associated with the most recent versions of the software modules available at the telematics call center **180** for operation of the controller operated vehicle components **114, 116** in a specific vehicle **110** in accordance with one embodiment of the present invention. If the telematics unit **120** was previously installed in a different vehicle **110**, the telematics unit **120** will have the unique vehicle identification tag for the previous vehicle **110** stored in the in-vehicle memory **128**. The vehicle software configuration data stored in the in-vehicle memory **128** will also be specific to the previous vehicle **110**. If the telematics unit **120** is a new unit and newly installed in the vehicle **110**, default parameters for the unique vehicle identification tag and vehicle software configuration data will be stored in the in-vehicle memory **128**. In one embodiment, the unique vehicle identification tag is a vehicle identification number (VIN) for the vehicle **110**.

The method for updating the vehicle software configuration in the telematics unit **400** begins (block **405**) with the telematics unit **120** requesting the unique vehicle identification tag for the vehicle **110** (block **410**). The telematics unit **120** retrieves the vehicle identification tag stored in the in-vehicle memory **128** (the memory in the telematics unit) (block **412**). The telematics unit **120** compares the unique vehicle identification tag received from the vehicle **110** to the unique vehicle identification tag retrieved from the in-vehicle memory **128** (block **415**).

If the unique vehicle identification tag received from the vehicle **110** does not match the unique vehicle identification tag stored in the in-vehicle memory **128**, the received unique vehicle identification tag is stored in the in-vehicle memory **128** in the telematics unit **120** as the unique vehicle identification tag for the vehicle **110** (block **420**) and the method then continues to the step outlined in block **425**. If the received unique vehicle identification tag matches the stored unique vehicle identification tag, the method progress directly the to the step outlined in block **425**.

The telematics unit **120** then contacts the server **181** at the telematics call center **180** and issues a check status flag. The telematics unit **120** requests the software configuration data corresponding to the unique vehicle identification tag (block **425**). The server **181** identifies the record associated with the unique vehicle identification tag. The identified record contains the software configuration data for the vehicle **110**. The software configuration data includes the software module identification tags for the most recent versions of the software modules available at the telematics call center **180** for the operation of the controller operated vehicle components **114, 116** in the vehicle **110**. The software configuration data is transmitted from the telematics call center **180** to the telematics unit **120** (block **430**). The telematics unit **120** stores the received software configuration data in the in-vehicle memory **128** (block **435**).

FIG. 5 is a flowchart for a method of upgrading the software modules in the vehicle **110** in accordance with one embodiment of the present invention. In one embodiment, the telematics unit **120** periodically issues a status check flag to the telematics call center **180** to see if an upgraded software configuration data is available for the vehicle **110** and updates the software modules in accordance with the updated software configuration data. For example, the telematics unit **120** issues a status check flag every engine ignition cycle, or once every predefined time period such as once a week, once a month or once a year. In another embodiment, the telematics call center **180** initiates the upgrade process by issuing an update flag to the telematics unit **120** of a vehicle **110** when an upgraded version of a software module for the vehicle **110** is released to the telematics call center **180.** In one embodiment, the telematics call center **180** sets a new software flag whenever an updated version of a software module is released. Responsive to the new software flag the telematics call center **180** identifies the vehicles **110** adapted to utilize the updated software module and issues an update flag to the telematics units **120** of those vehicles **110**.

In another embodiment of the present invention, a new vehicle component **114, 116** is installed in the vehicle **110** and the newly installed vehicle component **114, 116** requires a specific software module for operation. The telematics unit **120** identifies the presence of a newly installed vehicle component **114, 116** and initiates the process by issuing a status check flag. In one embodiment, the newly installed vehicle component **114, 116** includes a version of a software module. In another embodiment, the newly installed vehicle component **114, 116** includes default parameters identifying the software module required for operation.

The method for upgrading the software modules in the vehicle **500** begins (block **505**) with the telematics unit **120** retrieving the software identification tag for the software module that is actually installed in a vehicle component **114, 116** (block **510**). The telematics unit **120** issues a request to a vehicle component **114, 116** for the software identification tag for the software module that is actually installed in the vehicle component **114, 116**. The software identification tag identifies the vehicle component **114, 116** that the software module is adapted to control and the software module version number. The telematics unit **120** requests the software identification tag for the most recent version of the software module available from the telematics call center **180** (block **515**). In one embodiment, the telematics unit **120** already has an updated software configuration data in the in-vehicle memory **128**. The telematics unit **120** retrieves the software identification tag from the in-vehicle memory **128**. In another embodiment, the telematics unit **120** retrieves the software identification tag from the central database **182**. The telematics unit **120** transmits the software identification tag to the server **181** at the telematics call center **180**. The server **181** checks the central database **182** to identify the software identification tag for the most recent version of the software module and transmits the software identification tag back to the telematics unit **120**.

The telematics unit **120** compares the software identification tag retrieved from the vehicle component **114, 116** with the software identification tag for the most recent available version of the software module (block **520**). If the software identification tag retrieved from the vehicle component **114, 116** matches the software identification tag for the most recent available version of the software module, the most recent available version of the software module is already installed in the vehicle component **114, 116** and the process ends (block **525**). If the software identification tag retrieved from the vehicle component **114, 116** does not match the software identification tag for the most recent available version, the most recent available version of the software module is not installed in the vehicle component **114, 116** and the telematics unit **120** requests an updated version of the software module from the server **181** at the telematics call center **180** (block **530**). The telematics unit **120** transmits the software identification tag for the most recent available version of the software module and the server **181** uses the received software identification tag to retrieve and transmit the associated software module. Once the telematics unit **120** receives the updated software module, it replaces the older version of the software module in the vehicle component **114, 116** with the updated software module (block **540**). Method **500** ends at **525**.

The above-described methods and implementation for the vehicle software configuration management and associated information are example methods and implementations. The actual implementation may vary from the method discussed. Moreover, various other improvements and modifications to this invention may occur to those skilled in the art, and those improvements and modifications will fall within the scope of this invention as set forth below.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive.